Abiotic Stem Damage

Injury or damage from non-living agents

Cause—Common causes of injury or damage to stems by non-living agents include mechanical abrasion, physical constriction, fire, lightning strikes, hot and cold extremes, and high winds.

Hosts—All tree species throughout the Rocky Mountain Region can be damaged. Species with thin bark and most young trees are more susceptible to mechanical damage, fire, freeze injury/sunscald, solar heat injury, frost cracks, and hail.

Signs and Symptoms—Common damages in the Region:

- Mechanical damage is caused by impacts or rubbing from various sources such as vehicles (skidders, cars, etc.), falling trees or branches hitting other trees, people chopping with axes and hatchets, or other contact sources (fig. 1). Mechanical injury may lead to resin production in conifers, and callus ridges eventually form at the edges of the damage. Initially, scarring or deformation of the tree results. Depending on the wound size, the callus can form new bark over time and the wound can heal. The wounds allow entry of wood-decay fungi. If trees are damaged completely around the stem (girdled), the part above the girdle dies.
- Fire injury can be from direct burning or from radiant heat (figs. 2-3). Initially, fire injury is obvious and mortality is common. Fire scars can be superficial or deep and are often resinous on conifers that are not killed. Callus ridges eventually form at the edges of the damage on trees that survive the initial fire. Over time, some evidence of char usually can be found on the bark and/or on exposed wood at the base of trees. Trees that survive the initial fire injury are often attacked by diseases such as root, butt, or stem decays and/or by insects such as bark beetles.
- Lightning can result in direct mortality. However, in most cases, trees are only slightly damaged (figs. 4-5). Trees can be blown apart at impact, or lightning can cause fires that result in fire injury. More often, damage is in the form of a long, narrow furrow in the bark with thin layers of wood blown out. The furrow often extends down to the soil and may spiral to some extent. Bark beetles occasionally colonize trees soon after lightning strikes, and the wounds can allow entry of diseases, especially wood decays.
- Freeze injury/sunscald is caused by a sudden drop in temperature in the winter (i.e., sudden freezing temperatures) that damages sun-warmed and, therefore, non-hardened cambium (fig. 6). Symptoms are seen on the south to southwest side of stems. At first, the bark is discolored; if the injury is severe enough the bark will become rough and dead bark will flake. If the cambium is killed, the scar extends to the sapwood and bark is eventually sloughed off. Little or no resinosis results. A ridge of callus will form between live and dead cambium.
- Solar heat injury looks similar to freeze injury/sunscald but occurs when bark is suddenly exposed to intense sun (heat), which can result from pruning or stand thinning. This does not occur if the bark developed in the sun or when the bark is slowly exposed to the sun, and it only occurs in thin-barked species. As with freeze injury/sunscald, solar heat injury occurs on the south to southwest side of stems and produces the same symptoms. Damage to stems from solar heat is not well documented and is occasionally referred to as sunscald.

Figure 1. A mechanical wound caused during logging. *Photo: Susan K. Hagle, USDA Forest Service, Bugwood.org.*

Figure 2. Old fire scar with intact bark covering most of the injury. *Photo: Susan K. Hagle, USDA Forest Service.*

Figure 3. Charred bark and resin flow are common symptoms of fire damage. *Photo: Kurt K. Allen, USDA Forest Service.*

Figure 4. Lightning-struck trees are often attacked by bark beetles or decay fungi. *Photo: James T. Blodgett, USDA Forest Service.*

Figure 5. Lightning injury to an elm. *Photo: William Jacobi, Colorado State University, Bugwood.org.*

Figure 6. Sunscald on the south side of thin-barked trees. *Photo: Susan K. Hagle, USDA Forest Service, Bugwood.org.*

- Frost cracks are caused by an extreme drop in temperature during the winter when trees are dormant (fig. 7). Shrinking of the bark or outer wood as it cools quickly, compared to warmer inner wood, causes the bark or wood to separate or split. This can cause short or long cracks that are usually vertical, but long cracks can spiral somewhat on the stem. Unlike lightning damage, frost cracks usually have little bark loss. Cracks can form deep into the wood. Frost cracks seldom result in mortality. However, this damage often leads to extensive heartrot when cracks extend deep into the stem. Callus ridges form on both sides of the crack.
- Mechanical girdling is caused most often by people wrapping wire, rope, or other objects partially or completely around trees (figs. 8-9). Vines or other natural objects occasionally cause mechanical girdling. Because trees continually grow in diameter,

Figure 7. Long, vertical frost crack. *Photo: James Solomon, USDA Forest Service, Bugwood.org.*

Figure 8. Girdling by barbed wire. *Photo: Robert L. Anderson, USDA Forest Service, Bugwood.org.*

Figure 9. Girdling by a wire. *Photo: Francis Gwyn Jones, Bugwood.org.*

mechanical girdling can eventually result in tree mortality or mortality of the part of the tree exposed to the girdling object.

- Hail damage is a type of mechanical damage caused by hail impacts (figs. 10-11). This damage often affects trees in a larger patchy area, is directional (on the upper side of horizontal branches), and does not girdle stems or branches. Therefore, stem and branch mortality does not occur unless the stems or branches are snapped by the impacts. Initial scarring results, but if trees are not infected by diseases such as pine shoot blight or other canker diseases, callus ridges eventually form and wounds heal.
- Wind damage from very strong winds can result in snapping of the main stem (fig. 12). This type of damage is not common with healthy stems in the Rocky Mountain Region but has been reported. Snapping or breaking of stems is common when associated with decay. Snapping associated with stem decay or root and butt rot can occur in conditions from no wind to high winds. Snapping of solid (non-decayed) stems requires very high winds and usually results in many damaged trees in an area in a short time. Wind-broken wood has a more jagged appearance than breaks associated with decay. Winds can also shake stems, causing separation of annual rings. Resin deposition in wood at the damage site and/or wood separation can result in significant log defects.

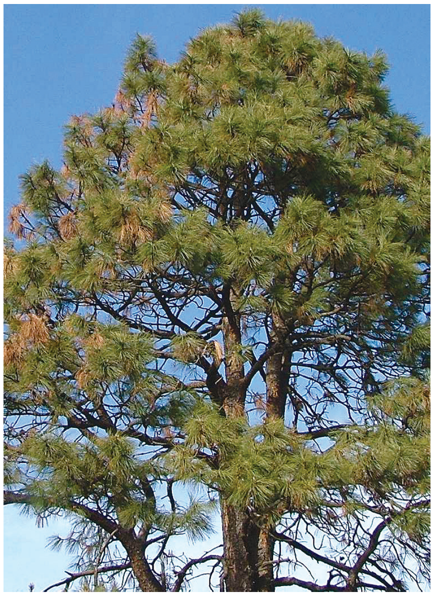

Figure 10. Directional damage caused by hail. *Photo: James T. Blodgett, USDA Forest Service.*

Figure 11. Close-up of hail damage on an aspen. *Photo: Steven Katovich, USDA Forest Service, Bugwood.org.*

Figure 12. Damage from strong winds. *Photo: Gil Wojciech, Polish Forest Research Institute, Bugwood.org.*

Impact—Direct losses from abiotic stem damage are usually minor compared to those caused by diseases and insects, with the exception of fire. In some situations, many trees and/or species in an area are affected (such is the case from fire, high wind, and hail), and in other situations, only individual trees are damaged. Extensive damage from any of these agents can result in growth loss, stunting, or mortality. Wounds are important as points of entry for diseases (especially cankers and wood decays) and insects. Callus ridges are the result of natural healing of trees as new bark forms around damaged bark. In most cases, callus will form and trees will recover if not attacked by diseases or insects.

Management—There are few management options for most of the abiotic stem damages, with the exception of mechanical damage and mechanical girdling caused by people and fire damage. Care should be exercised in pruning and thinning to avoid sudden exposure that could lead to freeze injury/sunscald, solar heat injury, or frost cracks.

For mechanical damage and mechanical girdling caused by people, public education is the best option. For mechanical damage associated with logging, options include: minimize stand entry during management, keep vehicles away from leave trees, use bumper trees, and include fines or value reductions in contracts for the number of trees damaged.

Fire management should include elements of fire prevention and fire suppression. Because many fires are caused by people, public education is the best option. Methods that reduce the spread of fires such as reducing fuel loads, thinning stands, and creating firebreaks will reduce the number of trees damaged. After fire, prompt salvage cuts can be used to remove trees of value before they are colonized by decay fungi and wood borers. Sanitation cuts can be used to remove damaged trees, if consistent with management options.

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1. Boyce, J.S. 1961. Forest Pathology. New York, NY: McGraw Hill Book Co. 572 p.

2. Sinclair, W.A.; Lyon, H.H.; Johnson, W.T. 1987. Diseases of trees and shrubs. Ithaca, NY: Cornell University Press. 574 p.